

## 4 ■ Modern Rationalism

Ladies and Gentlemen: I am sorry that I must read this lecture instead of speaking without any notes, but I don't speak English very well. However, this has one advantage, that it will make me speak without any ambiguity: a person who is familiar with the language is, as a matter of human nature, often inclined to be eloquent and therefore often vague. Since I am dealing with a difficult and diffuse subject, the utmost clarity and precision is necessary in words and expressions. First of all, I must state my premises so that we will find a common ground. I am going to speak about the relationship between Rationalism and Capitalism. I am not an economist, so I can't consider the question from the point of view of economics. Since my field is the History of Science and what people generally call Philosophy, naturally I approach the subject from this angle. But I should say here that the delimitation of different sciences, however necessary it seems to be, is somewhat dangerous. We are accustomed to filing the truth in a certain number of drawers, such as Religion, Politics, Economics, Science, Art. These subdivisions of the truth are apt to depend not on the

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The time and place at which this lecture was delivered are not known. Presumably Klein delivered it at some time in 1938–1940 as a guest speaker in a class on Rationalism and Capitalism.

nature of truth itself but on the number of drawers we have, so that we may easily miss the essential features of the subject, which may take on entirely alien features. It is a danger that we must always bear in mind.

Since the fourteenth century, man has undergone a profound change in his way of thinking, in his attitude towards the world, in his general behavior. This development was almost accomplished by the seventeenth century, when modern man, in the sense in which we use the expression now, became apparent. There is, as you know, the Marxist concept of the leap to freedom, a concept applied to the future, to something that has never occurred before. When you look at the change in man completed in the seventeenth century, you can't help saying that that change was also really a jump—perhaps to freedom, perhaps to slavery. This jump was concurrent with the rise of what we term capitalism. At the same time began the rationalization of all human life. When this term rationalization is used, as I think it is used in this class, it is applied to the following extraordinary phenomenon: we live in an entirely ordered world. Every day we get our mail at the same time, except of course when the postman is late; the subway runs regularly, although occasionally there may be an accident; all kinds of timetables, statistics, measures govern our lives, although not always precisely. Our whole life is modeled on certain patterns.

I intend now to study this kind of rationalization more carefully, leaving aside all facts that are at the root of our economic system. Whatever explanation you may give for the development of the world since 1600, either by invoking divine providence or by relying on the Marxist interpretations of history or by trusting to liberal economic theory, you can't deny that this development is primarily dependent upon a certain frame of mind, on a certain way of thinking. It is in this connection that we generally speak of rationalism. I shall try to explain what rationalism does not mean, what it can mean, and what it ought to mean.

First, we must disregard the meaning of the word "rationalism" as being opposed to the word "irrationalism." The literal sense of the word "irrational" is "nonsense," and it is really a pity that this word nowadays should (and does) mean anything else. I think it is not useless to remind you of the fact that the

emphatic use of the words “irrational” and “irrationalism” has come into being only since the work of Henri Bergson, which as a whole is of tremendous importance for the understanding of the mentality of present-day Europe. I do not overestimate the influence of scientific or philosophic books on people in general, but it seems to me that each important book of this kind is only an expression of a certain unconscious public sentiment, which after a certain passage of time—generally thirty years—is awakened to consciousness by those books which it has inspired. From this time on, this opinion is expressed without doubt or hesitation, however inconsistent it may be.

Rationalism, as the opposite of irrationalism, is considered at the present time, especially in Europe, as something inferior, as something lacking in vitality. It is supposed to apply to things which are dead, whereas the irrational power of man, especially of artists, reaches heights and depths which are not accessible to the mere intelligence. As if there were anything in this world of more value and more power than the intelligence of man.

I think we can completely set aside this use of “rationalism” as opposed to “irrationalism” as being quite meaningless. As a matter of fact, the use of this word implies a more positive significance than mere opposition to irrationalism. This significance is attached to the early and most fundamental stage of modern thought. In this stage rationalism became opposed to empiricism; or more exactly, a certain school of thought, beginning with John Locke, created, through contradiction of a certain point in the work of Descartes, an opposition between empiricism and rationalism. In order to understand this opposition and, by implication, the meaning of rationalism, we must consider for a moment the general aspects of the philosophy of Descartes.

The thinking of Descartes resulted in the conception of two kinds of being which was likewise one of the most important premises from which he started: the *res cogitans*, the thinking substance, and the *res extensa*, the extended substance. The “thinking substance” meant for Descartes what has always been and is still called intelligence, mind, soul or consciousness, in a broader sense, the inner world, while the “extended substance” constitutes the external world. There is no connection whatever between them, except for one particular part of the human body,

namely the pineal gland, where they mysteriously meet through the agency of a third substance, God. The question immediately arises how the external world can be known through the intelligence, how the thinking substance and the extended substance can get into touch with each other, since they are totally alien to each other. Even our simplest acts become incomprehensible. If, for example, I wish to pick up my pencil, my arm must make the proper movement. But how can a wish belonging exclusively to the “thinking substance” initiate such a movement as belongs purely to the “extended substance”? Furthermore, how can any object in the external world be received in the mind and become a matter of knowledge? In the attempt to answer these questions (the so-called psycho-physical problems) a philosophical discipline arises known as the theory of knowledge.

Descartes’ attempt to solve this problem by plotting the meeting of the two substances in the pineal gland was obviously unsatisfactory. However, no matter what the procedure might be by which we attain to knowledge, one condition according to Descartes is indispensable: that the thinking substance have within it such qualities as correspond to similar qualities of the external world. Using ancient terminology, he calls the qualities of the mind *ideae innatae*, innate ideas, which guarantee the possibility of a perfect knowledge of the external world. They are (apart from the idea of God) number, magnitude, figure, space, time, and movement.

I have emphasized this doctrine of Descartes, namely that of the *ideae innatae*, because it was precisely this alone to which Locke and the entire school of empiricists objected. Locke and his followers contend that there are no such *ideae innatae* but that all the knowledge of the external world is the result of experience by means of the senses. Ever since that time this divergence between the two schools of thought has existed, one, the rationalistic school, proclaiming the sufficiency and power of intelligence for complete understanding of the world, and the other, the empiricist school, denying the sufficiency and power of intelligence and relying rather on the capacity of our senses. For the latter, therefore, the theory of knowledge is the subject matter of psychology. From this follows one definition



of rationalism. It is that the essential reality of the external world is accessible to pure intelligence and to pure intelligence alone.

However, don't overlook [the fact] that the fundamental distinction of Descartes' between thinking substance and extended substance, the external and inner worlds, is universally accepted by the empiricists as well as by the rationalists; furthermore, that the essential premises of the empiricist psychology as well as of all contemporary physiology have been established by Descartes himself in his book, *Les passions de l'âme*. Above all, the difference between the two doctrines as regards the *ideae innatae* becomes totally unimportant in comparison with the agreements implied by the acceptance by both schools of the truths of mathematical physics, the main principles of which were again also first established by Descartes. Rationalists and empiricists, differ as they may on the question of how we acquire knowledge, must be in full agreement on the methods of thinking involved in the principles of mathematical physics. Mathematical physics is the most important part of our entire civilization and actual life. This is true not only in respect to the technics so inseparable from our modern life, and not only because it determines our own understanding of the world, but also because the principles of mathematical physics are basic to our whole way of thinking and behavior. We are therefore led to a new and more exact definition of rationalism. In a broader sense rationalism is that approach to an understanding of human behavior, history and the world around us implied by the premises of mathematical physics.

Now what are these premises of mathematical physics and therefore of all our thinking? The answer to this will give us a deeper insight into the character of rationalism as I think we must understand it. First of all, the science of nature as initiated by Descartes (and parenthetically this would apply also to Galileo) presupposes the distinction between thought and the external world as totally disconnected entities. All efforts to bridge the two and the claim that intelligence is sufficient to grasp the external world (as in mathematical physics) must not make us overlook the fundamental fact that this dichotomy involves a profound distrust of the reality of the world. The mere fact that we question the possibility of receiving the outside

world and the manner in which it may be received, that is, the very existence of the theory of knowledge, indicates the deep cleavage between mind and the outside world. The fact of supreme importance is that we consider our mind as a mind shut up within its own cell, that we consider our soul as a soul isolated and without any possible contact with the outside world. Hence the paradox that the mind which is taken to be all sufficient for understanding the world is preconceived as being entirely dissociated and alienated from the world. This is a strange kind of rationalism indeed! Still stranger when we compare it with the thinking of the ancients.

There, though there is a clear distinction between mind and world, there is no separation between them, but rather mind is very emphatically the receiving of the world and nothing but that. As the Greeks put it, we receive the world in our mind by means of the λόγος. Λόγος comes from λέγειν, which means "to speak." By speaking we do not mean merely the pronunciation of a conglomeration of words, but the telling of something to someone. The literal and correct Latin translation of λόγος is *ratio*, which implies that speaking about a thing is understanding it, although the understanding may not be perfectly clear. The task of philosophy, according to the Greeks, is to make the speaking which is common to everyone perfectly clear.

We could rightly call the ancient thought rationalistic in the sense that for the ancients world and mind are inseparable from each other, that the nature of the world consists in being comprehensible. This is not just another philosophical theory but the very premise of their whole thought. *Modern* thought issues not from the understanding of man through speech but from the idea of a universal science, the *mathesis universalis*. Curiously enough, the idea of such a science is the result of an interpretation of certain passages in the commentary to Euclid's *Elements* by Proclus. Proclus refers in these passages to a general mathematical science which does not apply to numbers or figures or anything else but to relationships and proportions between such mathematical objects in general. Apart from a few axioms and postulates, he has in mind the fifth book of Euclid's *Elements*, the so-called general doctrine of proportions, the real author of which is, as we know, Eudoxus. The man who translated this book of Proclus into Latin in 1560, Barocius,

added to his translation a number of marginal notes. He marked these passages with the words "Divine Science" (*Divina Scientia*).

On the other hand, the general doctrine of proportions was combined with the *arithmetics* of Diophantus, which contained the solution of equations of the first and second degree. Thus, the general doctrine of proportions became identical with the general theory of equations and was interpreted as the *mathesis universalis*, the universal science. Since algebra, a doctrine familiar to the Arabs and known in western Europe since the thirteenth century, was similar to the doctrine of Diophantus, algebra was also identified with that same universal science. I hope you will forgive me for recording all these details, but they seem indispensable for our purposes. As a matter of fact, the idea of the universal science in the form of algebra becomes the dominant idea of the sixteenth and seventeenth centuries and develops ultimately into the system of our mathematical physics. Therefore we can try to determine the main premises of our physics and consequently of what we have already defined as rationalism by investigating the structure of the *mathesis universalis*.

The first point is this: algebra as the universal science is characterized as an art. This means that the universal science itself is interpreted as an art. What do we understand by this statement?

For the Greeks, as well as for the medieval tradition, science is the systematic representation of the truth. The "universal science" of the seventeenth century is conceived not as a representation of the truth but as the art of *finding* the truth. Descartes, as well as Vieta and Stevin, the founders of modern mathematics, reject entirely the idea that mathematics consists of representing and *proving* a certain number of true theorems. Descartes speaks contemptuously of such sterile truths (*steriles veritates*). The purpose of these mathematicians is to find the way in which all possible truth can be found. Algebra, the so-called "great art" (*ars magna*) is the "art of finding" (*ars inveniendi*). More exactly, the "universal science," in the form of the "art" of algebra, is nothing else but the finding of the way of finding the truth. Therefore, science as an art becomes primarily a method. Our modern idea of science is inseparably linked with the idea of a methodical procedure, according to certain rules. It is

noteworthy that the idea of procedure as a goal in itself was totally excluded from Greek science. In modern science there are no definite borders between pure science on the one hand and the so-called applied sciences and technics on the other. Modern science, as a whole, is not only applicable to certain procedures, the result of which is technics, but is in itself technical. Despite its heritage of the idea of ancient science, modern science is not so much the understanding of nature as the art of mastering nature. The rationalism of modern science consists mainly in the rationalization of methods, and it results in that extraordinary organization of our whole life, which we mentioned earlier.

By what means does modern science attain its goal? At this point I can't avoid disturbing you with some rather unusual observations. I must speak about the nature of concepts. Concepts are supposed to be a very familiar institution, but I can assure you that it is by no means easy to determine their true character.

Generally speaking, there are two kinds of concepts, those which apply to objects and those which apply to concepts themselves. If I say, "This is a *dog*," or "This is *red*," the words "dog" and "red" are concepts, used here to indicate individual objects. But if I say, "Red is an *attribute*," or "Idealism is a *theory*," the words "attribute" and "theory" are concepts applied not to individual objects but to concepts, "red" in the one case and "idealism" in the other. Since Albertus Magnus, scholars have called the first class of concepts "*intentiones primae*" or literally "first concepts," and the second class has been called "*intentiones secundae*." The ancient sciences dealt chiefly with concepts of the first class, while philosophy, or, more exactly, the main philosophical doctrine, was chiefly concerned with concepts of the second class. This distinction has nothing to do with abstraction. Every concept is, as such, abstract. That is, the concept is drawn, is abstracted, from individual objects, is general in itself, and has its own reality only in the mind. Abstraction, an Aristotelian term, means a process of our thought by which, for instance, the concept of "dog" is drawn from individual dogs as something common to all of them, or, the concept of a mathematical triangle is drawn from objects of triangular shape. Unfortunately, this word is applied today to the description of



all kinds of concepts and has even come to have a derogatory connotation. I fear that some of you may be tempted to apply this magic word to my own statements.

Now, what kind of concepts are used by the “universal science”? How can we describe the nature of symbols as they are used in algebra? In answering these questions we are approaching the second and major point which characterizes the idea of the “*mathesis universalis*.” We are all familiar today with the kind of symbolic notation used in algebra. We write, without any difficulty, such formulae as  $(a+b)^2 = a^2 + 2ab + b^2$ , or,  $ax^2 - bx + c = 0$ . However, a considerable effort was necessary to produce such a symbolic “language.” This effort, made by the end of the sixteenth century, is usually interpreted as the last step in a long line of development, a step necessitated by the progress of algebraic knowledge and procedure. This may be true, but we ought not to forget that Greek mathematics, despite its extraordinarily high level, could not conceive such a step. Actually the step to the symbolic notation of algebra and, therefore, to the conception of mathematical physics involves an entirely new way of thinking, presupposes an entirely new manner of handling concepts. The symbolic language of algebra, that is, the language proper to mathematical physics, is not a purely technical or instrumental matter. It is a common mistake to believe that we can translate the theorems of mathematical physics into ordinary language, as if the mathematical apparatus used by the physicists were only a tool employed in expressing their theorems more easily. The mathematical method of our physics is inseparable from the very nature of this science. It represents, moreover, the most important character of our general frame of mind, which we have referred to as rationalism. Take the following examples:

- (1) five horses and six horses make eleven horses,
- (2) five unknown quantities and the number six equal the number sixteen,
- (3)  $ax + b = c$ .

The transition from the first to the second can properly be described as the transition from concrete numbers to abstract

numbers, since the arithmetical number *six* is abstracted from any possible group of six objects. However, the transition from the second, which is an equation we can find in the textbook of Diophantus, to the third, which is an algebraic equation as used by the *mathesis universalis*, cannot be simply described as a greater degree of abstraction. If the step from the numerical coefficient, “five,” to the symbolic coefficient, “*a*,” can be understood at all as an abstraction, it is an abstraction of a peculiar kind. We will try now to explain this peculiar kind of abstraction or, rather, generalization.

Numbers—I mean “whole numbers”—belong to the first class of concepts. If I say, “There are four chairs here,” I indicate *first* that there are certain objects here, namely chairs, and secondly that there are just so many of them. If I say, “There is a certain number of chairs in this room,” I also indicate first that there are chairs here and secondly that there are many of them without stating precisely how many. This is the natural use of numbers, and the Greeks recognized only such a use. For the Greeks, number (ἀριθμός) meant precisely a definite number of definite things, for instance, four chairs, ten dogs, fifty people. Arithmetical numbers, that is, numbers used as objects of a science called arithmetics, are for them precisely of the same kind. The number four, as an object of arithmetics, means a definite agglomeration of neutral units, also called “pure” units. “Four” doesn’t mean the figure 4 but this :: . This simple fact is very important because we are spoiled by the use of the Arabic numeral system. Any arithmetical number is abstracted from the corresponding multitude of concrete things. For this reason the Greeks could not conceive of such a thing as an indefinite number “*a*,” because to them, by its very nature, a number meant a “definite number of definite things.” Therefore, their classic definition of a number was “a multitude of units,” as in the seventh book of Euclid, or a “definite multitude,” as Eudoxus put it.

Now, if we have an expression such as  $a + 2ab + c$ , what does “*a*” mean? “*a*” can mean, of course, any possible number of the kind the Greeks dealt with. “*a*” can be 4, or 6, or 150, or any possible one, but “*a*” is not 4, or 6, or 150, or any other one. Thus, “*a*” doesn’t mean certain objects, namely units, the multitude of which it indicates, but rather the *concept* of the

number as a multitude of units. So, at first glance, “*a*” belongs to the concepts of the second class, to the class of concepts which are applied not to individual objects but to concepts themselves. This, however, is only the first step. Actually, we deal with “*a*” and with all such algebraic numbers in exactly the same way as arithmetics deals with ordinary numbers. In other words, in algebra we use concepts of the second class as though they were concepts of the first class. We identify, in the process of algebraic thinking, concepts of the first class with concepts of the second class. What we call a symbol is nothing else but a concept of the second class interpreted as a concept of the first class. Therefore, we can now state that the “peculiar kind of abstraction” used in algebra is a *symbolic* abstraction. This is the peculiar kind of generalization involved in the idea of “universal science” which has developed into our science of nature, or mathematical physics.

This description of the two main features of the “*mathesis universalis*,” namely its character as an art and its functioning by means of symbolic abstraction, may appear very far from our subject. Remember, however, that the idea of the “*mathesis universalis*” determines that whole orientation of our lives which we call “rationalism.” Our rationalism is a symbolic one. It is the true result of the Cartesian distinction between “mind” and “external world.” It is the true expression of the paradox of which we have spoken, that the mind, which is supposed to be sufficient to understand the world, is preconceived as a mind alienated from this same world. We approach the world not directly but by means of concepts which are abstractions of abstractions and which at the same time we interpret as being in direct contact with the world.

These features of the *mathesis universalis*, which appear most forcefully in our Science of Nature and dominate our entire manner of thinking, can, I trust, be traced in the social and economic fields in which we live. Along the lines of our society, every one of us must “do his job” according to certain rules imposed on us by ever-working machineries. The production and consumption of goods have acquired a sort of “automatic” character. No one can escape the fatality which is the result of this automation. Our life, then, even our most intimate life, is completely conditioned by social and economic necessities which are alien

to ourselves and which we nevertheless accept as the true expression of ourselves. Our work, our pleasures, even our love and our hatred are dominated by these all-pervading forces which are beyond our control.

Thus, our own life does not belong to us. We appear to be in the most direct contact with the world around us, but in reality the vast machinery of our society permits us to perceive the world only through generally accepted views. The directness of our contact with the world is of the same symbolic character as the concepts we use to understand it. We can comprehend how our whole social and economic system, which we term Capitalism, and which is, in its origins, closely connected to the modern idea of knowledge and science, has acquired such symbolic unreality.

✓ There may be many ways to overcome this symbolic unreality. One of these ways is to understand how ancient science approached the world.